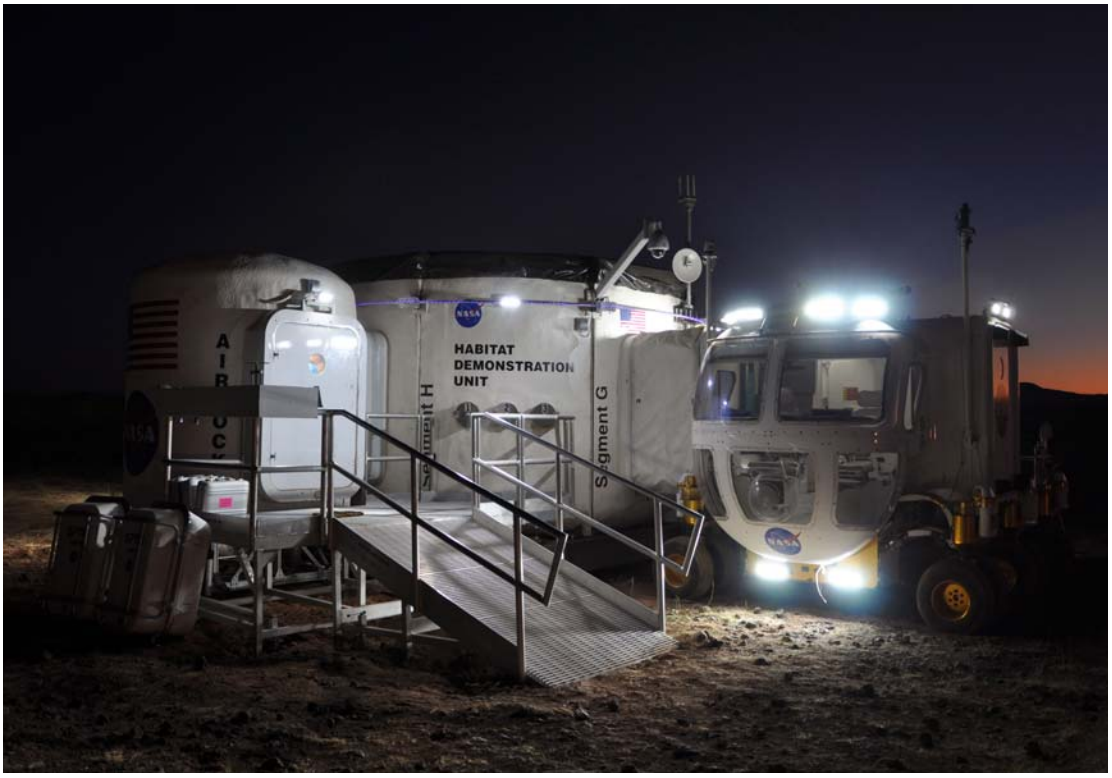
NASAfacts

Desert RATS – Research And Technology Studies



For more than a decade, engineers, scientists, astronauts and technicians from NASA centers across the country have gathered in desolate desert locations with representatives from industry and academia to hold dress rehearsals for future missions to asteroids, the moon and Mars.

This group and its simulated missions are part of NASA's Desert RATS – or Research and Technology Studies – program. In remote locations chosen for their resemblance to possible future destinations, the D-RATS team evaluates exploration methods, equipment and tools developed in laboratory settings in a real world environment. This helps the D-RATS team determine the system requirements necessary for exploring distant locations while developing the technical skills required of the next generation of explorers.

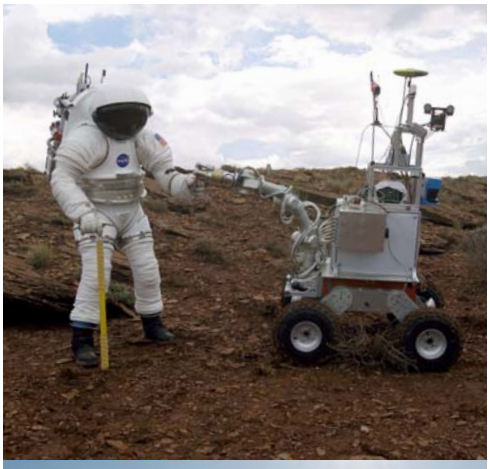
Desert RATS is one of a suite of NASA's analog tests. Each analog helps NASA test and validate future spaceflight mission architectures, conduct technology demonstrations and understand system-wide technical and operational challenges. For more information on Desert RATS and other NASA analog missions, visit www.nasa.gov/exploration/analogs.

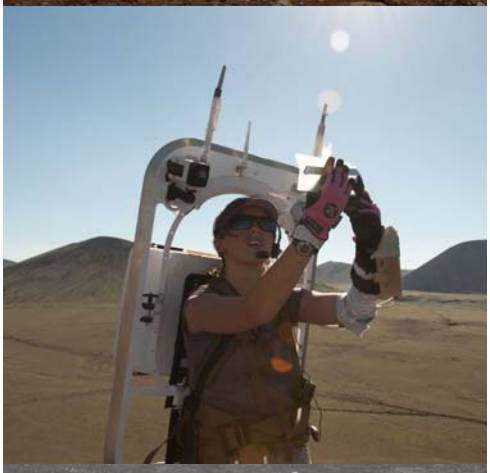
History

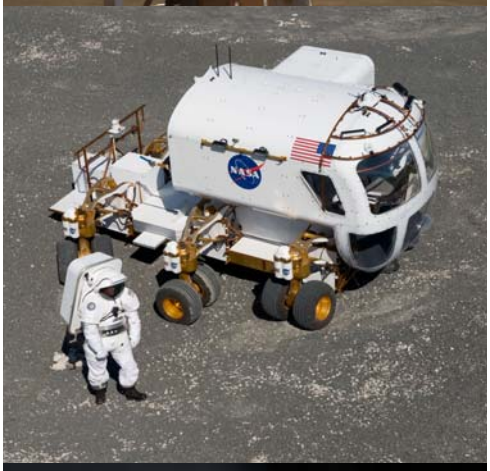
The first Desert RATS mission was held in 1997 with four people who believed NASA would eventually want to expand its exploration horizons beyond low Earth orbit once again and who thought they should start preparing for it.

Since then, the project has steadily grown in size and fidelity as it continues to return to the desert to test concepts and technologies destined for distant surfaces. Now more than 100 people from nine NASA centers, multiple universities, industry and international partners are involved in the tests, which have, at various times, involved astronauts and geologists living in the Space Exploration Vehicle for weeks at a time, robots scouting out locations for exploration and mobile laboratories following crews across the desert.

Over the years, the desert has stood in for the moon, Mars, and – in 2011 – a near Earth asteroid. However, the technologies and hypotheses tested will be applicable in a number of possible locations including high Earth orbit, Lagrange points or Martian moons. The key questions being asked – and answered – will help propel the next phase of human space exploration forward to multiple destinations.







2011

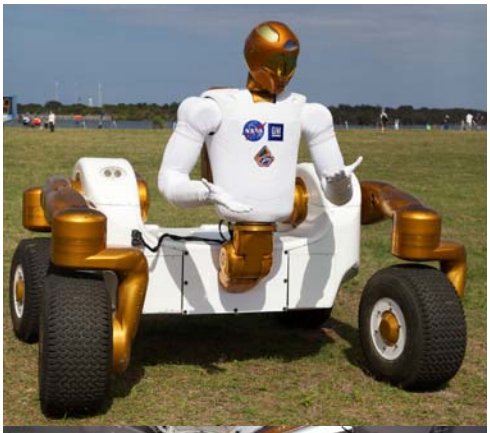
Desert RATS 2011 marks the 14th annual field test and the first time that a mission to an asteroid has been simulated. The possibility of visiting an asteroid presents NASA with challenges the agency is only beginning to tackle – while astronauts have visited the moon and engineers have landed rovers on Mars, no one has even simulated a mission to an asteroid. And although the Earth's surface, with its atmosphere and gravity, will never be the perfect stand-in for that of an asteroid, there are a lot of lessons to be learned without leaving home.

Some of the basic questions the D-RATS team will attempt to answer include:

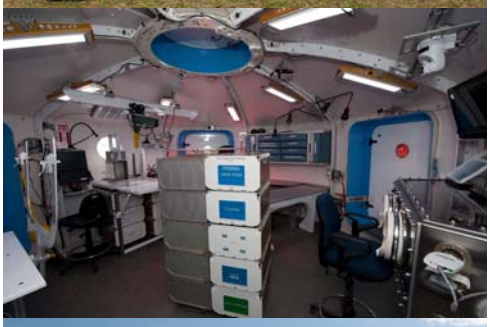
- What combination of systems and hardware will be most effective for exploration? Do we need a Deep Space Habitat, a Space Exploration Vehicle or some combination of the two? What robotic systems will we use, and how will we communicate with the crews?
- How many crew members are needed to explore a deep space destination such as an asteroid? Would Apollo's three-person crews be sufficient, or should an extra person or two be added?
- How should crews be split up upon reaching the asteroid? Should one stay inside while some or all of the others perform spacewalks? Can all members of the crew explore the surface in Space Exploration Vehicles, or does one need to stay behind in the Deep Space Habitat?
- What operational concepts should those back on Earth use to ensure mission success?
- What effect will communications delays have on the team?

To help answer that final question and add a new level of fidelity to the tests, the control team for this year's D-RATS tests will be located more than a thousand miles away, in Johnson Space Center's Mission Control Center.

Centaur 2
Robonaut 2, the latest generation of the Robonaut astronaut helpers, launched to the space station aboard space shuttle Discovery on the STS-133 mission. Developed in partnership with General Motors, it is the first humanoid robot in space, and although its primary job for now is teaching engineers how dexterous robots behave in space, the hope is that through upgrades and advancements, it could one day venture outside the station to help spacewalkers make repairs or additions to the station or perform scientific work. To help Robonaut 2 move around on Earth, NASA's Johnson Space Center has developed a series of Centaur rovers to carry R2 and other payloads. The Centaur 2 base will provide mobility for R2 at D-RATS and enable the world's most dexterous robot to explore and help answer some of those crucial questions about future exploration missions.



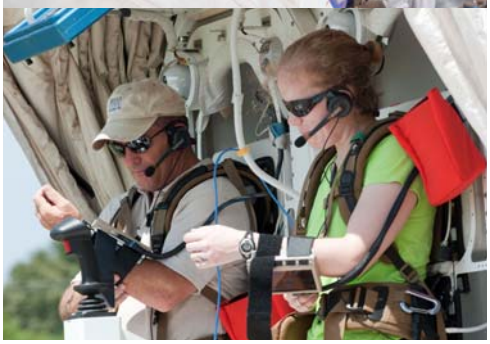
HDU-DSH – Habitat Demonstration Unit - Deep Space Habitat
After a long day of exploration, astronauts need a place to call home. But what will that look like? One of the possibilities being tested is the Deep Space Habitat, a new configuration of NASA's Habitat Demonstration Unit, which allows engineers to compare competitive operations concepts and technologies. Some of the new features being tested include a student-built loft living space developed as part of the X-Hab Academic Innovation Challenge, a porch for use as a deployable spacewalk platform and a dedicated hygiene module.



SEV – Space Exploration Vehicle
If you want to do productive exploration anywhere in space, you'll need a suitable vehicle. NASA is now testing concepts for a new generation of vehicles, building on lessons learned from the Apollo missions as well as from the unmanned Mars rovers. For the sake of flexibility, the SEV concept can adapt to different destinations and be used in space or on the surface. Its pressurized cabin can be used on top of a wheeled chassis to explore a surface with its own gravity (or to simulate exploration here on Earth). But where wheels are not needed – in space or on an asteroid – the same cabin can be used atop a flying platform.

Spacesuits
In past years, functioning spacesuits featuring advanced concepts were used for Desert RATS tests. Although they present little challenge in microgravity, on the Earth's surface their weight makes extended expeditions difficult. As such, lightweight mockups were adopted instead. For the 2011 D-RATS test, the crew will wear backpack frames to approximate the bulk and balance of a spacesuit backpack. The frames integrate into spacesuit ports on the SEVs that allow the crew to simulate spacewalk egress and ingress. To make scientific work on the spacewalks more efficient and autonomous, a suite of electronic tools have been packaged into a new Extravehicular Activity Information System inside the pack, with a high definition video camera and wrist-worn display.

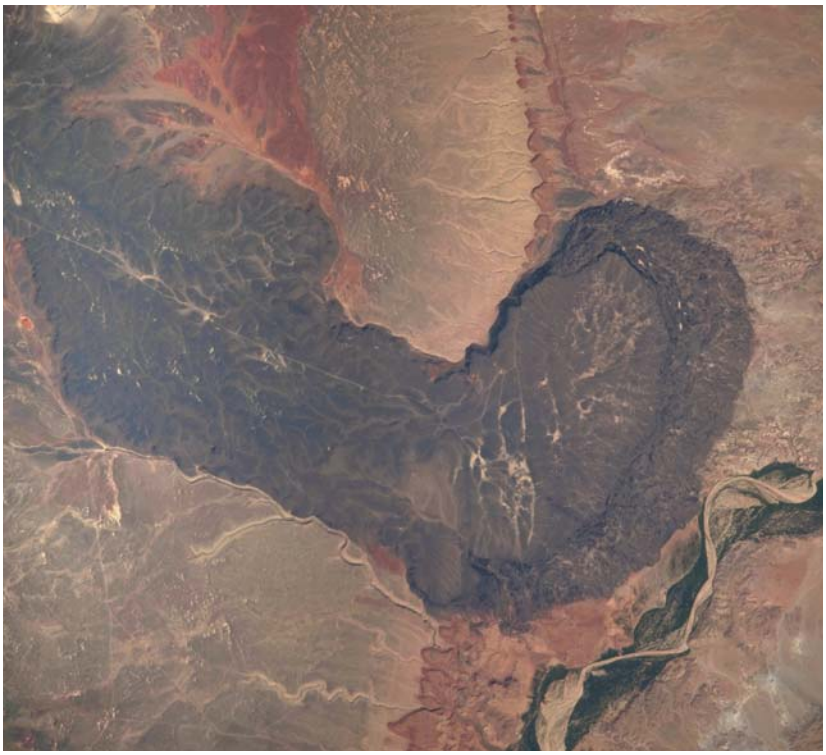
Operations and Communications
As humans move further away from Earth, new challenges will emerge in how day-to-day operations are handled, both for those in space and those at home. Communications delays will increase from the mere fractions of a second we experience with the International Space Station, to several minutes. In order to send back the scientific information gathered from these exotic locations, bandwidth requirements will grow. A variety of solutions for these and other challenges will be simulated as part of the 2011 D-RATS test to better define what will be needed for future missions.



Science and Operations
In 2011, D-RATS will test methods of conducting science support operations for human planetary surface exploration at a far target. During Apollo, and on previous D-RATS tests, the science team interacted with the crew directly over the communications system. In 2011, however, they'll experience a 50-second, one-way time delay, which makes it impossible to carry on a normal conversation. To set up the test, the US Geological Survey and NASA science teams identified a number of geological problem areas at the Black Point Lava Flow to be investigated by the crew. The mission of the combined Science Operations Team in Houston and the crewmembers in Arizona will be to understand the geology of these areas through crew field observations and geologic data communicated to the Science Operations Team. This permits testing a number of communications approaches, including text messaging between the science team, the crew in the Deep Space Habitat and the crew out performing spacewalks; through the use of digital imaging and geochemistry data; and periods where we have time-delayed conversations with the crew to discuss science plans. By determining which work well and which do not, more extensive testing can be conducted in the future on those techniques that show the most promise.

Mobile Mission Control Center
While the astronauts have the HDU-DSH as a home away from home during their exploration activities, the ground support, data management, and science and mission control folks need a home as well. The Mobile Mission Control Center provides that home for most of NASA's exploration analog activities and provides, or has provided, support for suit operations; science operations; video switching, storage, and retrieval; networking (including, wireless, cell routing and delay simulation); command teams; weather protection and the all-important air-conditioned refuge from the Arizona heat.

Black Point Lava Flow



Although NASA has used a variety of locations for Desert RATS testing in the past, Black Point Lava Flow has proven to be one of the best.

Over the course of the past six million years, a number of volcanoes have erupted about 40 miles north of what is now Flagstaff, Arizona, leaving behind cinder cones and a variety of lava flows with different surface characteristics. Since they came from the inside of the Earth, they provide insight into what the Earth is made of, how hot it is and how old it is – some of the same questions scientists want astronauts to help answer about asteroids and planets. So although the terrain is not exactly what scientists expect to find on an asteroid, it lets NASA teams simulate working on another celestial surface to evaluate how successful the equipment and processes designed for that work would be.

That's not only true of simulated missions to asteroids. In the past, Black Point Lava Flow has also stood in for the moon on multiple occasions – both as part of previous Desert RATS tests, and during the Apollo program. In the 1960s, craters were created at Black Point to duplicate those that Neil Armstrong and Buzz Aldrin planned to land near. It could also easily stand in for Mars or a number of other celestial bodies – volcanic rocks occur on the surface of all the inner planets, as well as some of the moons of Saturn and Jupiter.

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